Plant remains from Ullandhaug, an iron age farm site from the migration period in southwest Norway

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This paper presents the results of the first archaeobotanical examination from a prehistoric farming settlement in Norway. The farm site, Ullandhaug, was inhabited from ca. 350 AD and destroyed by fire ca. 550-600 AD. Charred and unburned plant remains were found in soil from fireplaces and cultural layers within the ruins. The analysis of the plant remains showed a dominance of hulled, four rowed barley (*Hordeum vulgare* var. *vulgare*) while oats (*Avena* sp.) was less strongly represented. Four flax seeds (*Linum ussitatissimum*) and one poorly preserved grain of millet (*Panicum* sp.) were also identified. Since ploughed fields were found at the farm site, it can be assumed that barley, oats and possibly also flax were cultivated there. Seeds of 15 species favoured by agriculture and human activities were also identified. Cereal grains, fruits and seeds found in the fireplaces were probably lost during food preparation. The material also contained carbonised remains of 10 species that grow as natural vegetation and that ordinarily do not grow on cultivated fields. Two of the wild species probably grew on grazing land. The other wild species may have been a part of heathland communities and other plant communities in the area surrounding the farm. The seeds of the wild plants, most of which were found in the cultural layer on the floor, may have been brought into the house with the hay or by the livestock. The identified species from Ullandhaug include those cultivated plants and weeds that were most common in other northwest European countries in the Migration Period.

Keywords: Southwest Norway, Ullandhaug, Carpel, Macrofossil, Fireplace, Heathland

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Introduction

Plant remains from archaeological sites and imprints of cereal grains and seeds in pottery can provide information about the types of plants cultivated by early farmers. The first collecting and sampling of prehistoric plant remains on a large scale in Norway was done at the farm site, Ullandhaug, in southwest Norway, which was excavated in 1968 and 1969. Before 1968, no systematic investigations of plant macrofossils from archaeological sites had been carried out in Norway. However, some imprints of cereal grains on pottery had been analysed sporadically, and uncarbonised plant remains from the Oseberg Ship were identified by professor Jens Holmboe (Holmboe 1921). Since 1972, our knowledge of prehistoric agriculture has greatly increased. During the last decades, many archaeological excavations, accompanied by archaeobotanical investigations, have been carried out in Norway, many of them in the county of Rogaland.

Fig. 1. Location of the Ullandhaug site in southwest Norway.

The main purpose of the analysis of the plant remains in the collected samples from Ullandhaug was to find out what kind of cultivated plants grew in the

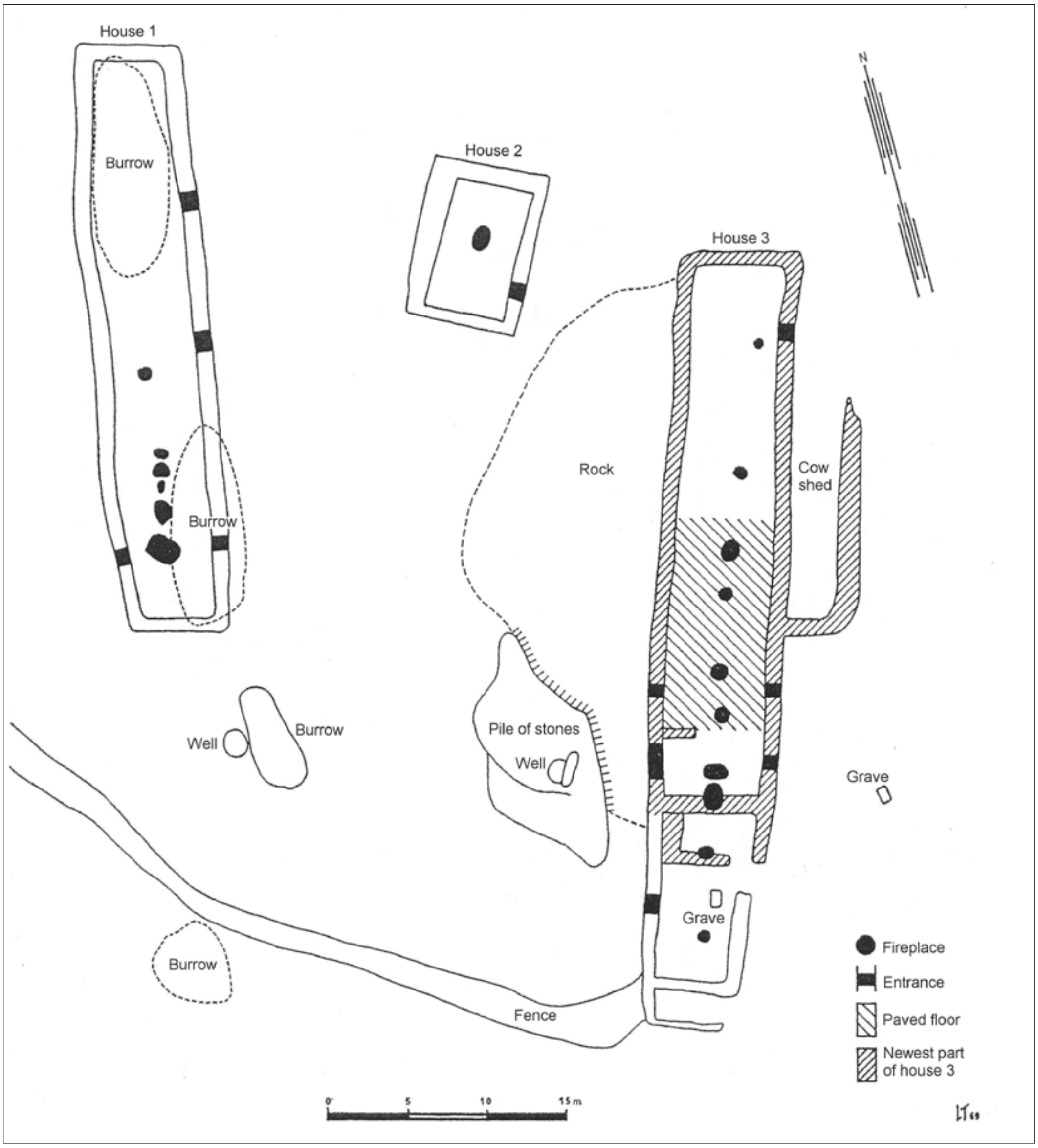

Fig. 2. Key map showing the farm site at Ullandhaug with farm houses and farmyard. From Myhre (1969).

fields of the prehistoric farm (Lundeberg 1972). A second aim of the investigation was to gain information about species of weeds and wild plants growing in the fields and in the areas surrounding the settlement. Maybe the macrofossils found in the soil can contribute to the knowledge of farming practices, daily life and ecological conditions in the farmland and outlying fields of Ullandhaug?

The Ullandhaug site

Ullandhaug is an Iron Age farming settlement near the city of Stavanger in southwest Norway (Fig. 1). The farm site is situated in a coastal area not far from the North Sea. The farm had three houses and about 5 hectares of cultivated land (Fig. 2). The settlement was established in the middle of the third century AD. The farm site was inhabited for approximately 250 years and abandoned in the last part of the sixth century because of a fire that destroyed the farmhouses (Myhre 1969). Charcoal from the floors was used for radiocarbon dating of the site. The charcoal pieces from the three houses date back to approximately 20–480 AD. The datings indicate the point in time when the trees from which the charcoal pieces originated were cut. Objects of antiquity found in the excavation indicate that the site was settled in the Migration Period. The archaeological excavation of the site was carried out in 1967 and 1968 (Myhre 1969).

Materials and methods

On the initiative of an English archaeology student, who was one of the workers at Ullandhaug the summer of 1968, the sampling of plant macro remains from cultural layers started. The sampling was carried out by 20 students who worked at the excavation at Ullandhaug. Those who collected the plant remains from the

soil samples had never done this before. A very simple technique was used. Soil samples from the fireplaces and from cultural layers were processed at the site by using a flotation method. They had no machines for flotation. Dry soil was shovelled into a bucket with water and they used household flour sieves to skim off charred cereal grains, seeds and fruits (Myhre 1969). The mesh size of the sieves is supposed to be approximately 2 mm. Plant remains were picked out by the excavators. According to the leader of the excavation, Bjørn Myhre, they primarily looked for cereal grains and did not search for smaller seeds. Therefore smaller seeds are most likely greatly underrepresented in the samples.

The prehistoric plant material from Ullandhaug consists of eight samples, each of them containing carbonised cereal grains, smaller seeds and fragments. Four samples were collected from four different fireplaces in house 3 and one from the fireplace of house1. The fireplace of house 2 had very thick cultural layers. Therefore two samples were collected from this fireplace, one from the top and one from the base. In addition plant remains were collected from the cultural layer on the floor of house 3. There are no samples from cultural layers of the floors in houses 1 and 2 because the excavation of these parts of the settlement was carried out in 1967, one year before the sampling of prehistoric plant remains started. All the plant material in the eight samples was analysed. A survey of the species and the number of cereal grains and seeds found in the different fireplaces of the three houses and in the cultural layer on the floor of house 3 can be found in Table 4. Plant remains that were heavily charred and difficult to identify to the level of genus or species are not included in Table 4.

The plant remains were handed over to Botanical Museum at the University of Bergen, where the material was sorted, cleaned and prepared for identification. Seeds, fruits and other plant remains were analysed using a binocular stereomicroscope (10× to 100× magnification). The plant macrofossils were identified by comparison with the reference collection of modern seeds and fruits at the Botanical Museum, University of Bergen, and with the reference collection at the Department of Agriculture in the School of Botany, University of Cambridge. Modern seeds and fruits were treated with chemicals (10% NaOH) to remove the epidermis cells in order to make them more like carbonised plant remains. Charring experiments with recent plant material were performed as an aid to identification. Measurements were carried out using an eyepiece graticule which was a part of the stereo microscope. Measurements were made of the length (minus embryo), breadth and thickness of the cereal grains (Fig. 3).

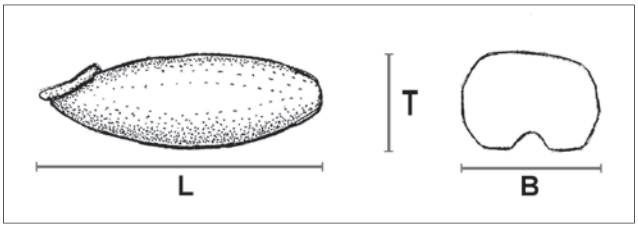

Fig. 3. Measurements of grains: L = length, B = breadth, T = thickness. Drawing: B. Lundeberg

One segment of a barley rachis was measured from the base to the top. Other plant remains such as fruits, fruit wall fragments and seeds were also measured (Table 3). Photographic equipment was the Tessovar photomacrographic system from Zeiss, which is designed for taking photographs of small objects (25–40 mm). The work with the identification of the plant remains was done from 1969–1971. The identification was done on the basis of literature that was accessible at that time (including Bertsch 1940, Berggren 1969). The basis for the identification of barley was the criteria proposed by Elisabeth Schieman (1948). In this article the results of the analysis are, to some extent, seen in the light of newer literature. The identified plant remains are presented in three groups; cultivated plants, weeds and ruderal plants, and other wild plants. The nomenclature is brought up to date and follows the newest flora of Norway (Lid & Lid 2005).

Results

Cultivated plants

More than 1000 charred grains of cereals were sorted out from soil samples collected in fireplaces and cultural layers in the three farmhouses at Ullandhaug. Many of the charred grains were not well preserved and the characteristics important for identification to higher taxonomic levels were missing.

Barley: 753 cereal grains were sorted out because their shape looked like the shape of barley, being broadest in the middle and narrower at the upper and lower end, seen from the dorsal and ventral side. The identification to species level was done on a selection of the 203 best preserved grains. Most of these grains had remains of chaff on the surface (Fig. 4b). Some grains had fine longitudinal stripes or lines in the fruit wall. These characteristics are distinctive features of hulled barley (Helbæk 1964). Many grains that were not very well preserved also had small remains of the chaff on their surface, usually in the ventral furrow.

Some of the grains were symmetrical; others were curved to the left or to the right (Fig. 4b). Lopsided grains were found in the selection of 203 well preserved grains as well as in the residual selection containing 550 more or less badly corroded grains. The

Table 1. Number of symmetrical and asymmetrical barley grains

Preservation	Number of cereal grains	Asymmetrical grains		Symmetrical cereal grains	Symmetry uncertain
		Curved right	Curved left		
Well preserved	203	23	27	50	103
Partly corroded	355	50	52	81	172
Poorly preserved	195	3	6	7	179
Total number	753	76	85	138	454
	100 %	10,10 %	11,30 %	18,30 %	60,30 %

presence of lopsided grains indicates that we are dealing with six rowed or four rowed barley (Helbæk 1955).

Two rachis segments were found, the one was quite well preserved and the other was broken. Both were attached to the same charred cereal grain. No chaff remains were found attached to the segments. The well preserved rachis segment was 3.36 mm long with tiny lengthwise lines (Fig. 4a). The size of the rachis segment corresponds to the lax-eared four rowed variety of barley (*Hordeum vulgare* var.*vulgare*).

Distinct grains of naked barley were not observed. This means that most of the barley grains probably belonged to the hulled variety. However, the presence of naked barley cannot be excluded. Size measurements for the 50 best preserved grains are presented in Table 2. The size of the barley grains from Ullandhaug corresponds with that of other finds from northwest Europe in the Iron Age and Migration Period (Helbæk 1957, Körber Grohne 1967, Van Zeist 1968)

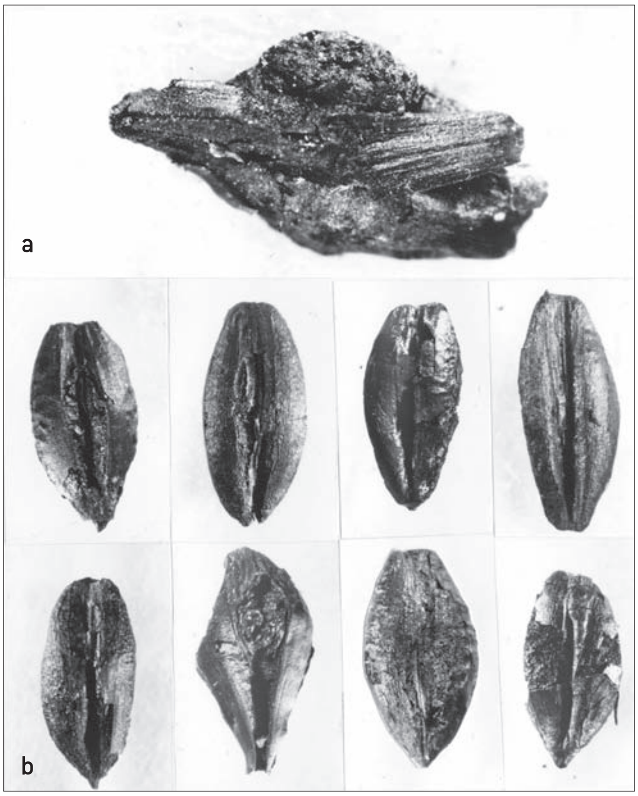

Fig. 4. *Hordeum vulgare. var. vulgare*: a) Rachis segment, b) Cereal grains. Scale bar 1mm. Photo: B. Lundeberg

Oats: 16 grains and 3 fragments were identified as *Avena* because they had a long and slender shape. The grains were broadest and thickest a little below the middle. These characteristics are distinctive features, typical for *Avena* (Körber Grohne 1967). Despite these common features, the size and the shape of the grains were variable. Some of the grains had the long and slender look typical for the lower grain of the *Avena* spikelet. Others were shorter and had a shape typical for the upper grain of the spikelet. As no chaff remains and no floret bases of *Avena* were found, it is not known whether the caryopsis derive from the cultivated *Avena sativa* or from *Avena fatua,* which occurs as a field weed.

Millet: One grain of millet was found in one of the fireplaces. Its length was 1.84 mm, breadth 1.2 mm and thickness 0.9 mm. Because the grain was badly preserved, the identification was difficult. The grain most likely is *Panicum milleaceum* because of its short and broad embryo (Fig. 5a–b). *Echinocloa crus galli* and species of *Setaria* have oblong embryos. However, this identification is uncertain because the grain was heavily corroded.

Flax: Four carbonised seeds had distinctive features typical of *Linum*. The seeds were moderately corroded with some small cracks on their surface. However, the seeds had the characteristic upper end which is pointed and a little bit bent to one side. The sharp edge on the sides which is characteristic for *Linum* was seen on the four seeds, especially near the pointed end. One of the seeds was oblong and flat like modern seeds of *Linum*. The other three were more drop-shaped. This shape most likely is caused by the process of carbonisation because seeds of *Linum* contain oils that will boil when the seed are heated. How much the shape of the seed will be changed, depends on the oil content and the intensity of the heat. (Helbæk 1959). This process makes the seeds shrink a little both in length and breadth. Based on the size and other distinctive features, these seeds can be identified as the species *Linum usitatissimum*. Size measurements for the *Linum* seeds are given in Table 2.

If the ratio between the breadth and length is considered, one will find that the breadth of the *Linum* seeds from Ullandhaug is small in proportion to the length compared with charred *Linum* seeds from other countries in northwest Europe. However, the size of

the seeds is within the normal variation for seeds of Linum ussitatissimum (Körber Grohne 1967).

Weeds and ruderal plants

It can be difficult to distinguish between the fruits of *Persicaria maculosa* and *Persicaria lapathifolia*. *Persicaria lapathifolia* usually has circular and flat fruits which are made of two carpels that coalesce at their edges. The base of the fruits is broad and the upper end is acute. The fruits of *Persicaria maculosa* are a bit more eggshaped and a little narrower at the base. However, the fruits of *Persicaria maculosa* can be built up from two or three carpels. Fruits which are composed of three carpels have a different shape with a more triangular cross section (Bertsch 1940, Timson 1963, Berggren 1969).

59 black and shiny fruits and numerous fragments of fruit walls had the characteristic marks typical of *Persicaria lapathifolia* or *Persicaria maculosa*. Some of the fruits were quite flattened (Fig. 6e), others were more or less swollen as a result of the process of carbonisation (Fig. 6d). The length of the fruits measured between 1.91 and 2.42 mm, which is the normal size for fruits of these species. Many of the fruits had broad base and could be identified as *Persicaria lapathifolia*. The swollen ones were more difficult to identify to the level of species. Three fruits were built up from three carpels (Fig. 6f). These fruits probably originate from *Persicaria maculosa*. Four carbonised seeds were identified as *Persicaria lapathifolia* (Fig. 6i).

Four carbonised fruits were identified as *Persicaria minor*. They were rounded with a narrow egg-shaped outline and pointed at the upper end (Fig. 6g). These fruits were built up from three carpels.

Persicaria hydropiper has slender, elliptical fruits which are rounded at the base and pointed at the upper end. The epidermis wall has a characteristic reticulum with bigger masks near the edges. Near the middle of the lateral faces of the fruits the masks are more extended. Five carbonised fruits had these distinctive marks and could be identified as *Persicaria hydropiper* (Fig. 6a).

Fallopia convolvolus has triangular fruits, whose upper and lower ends are pointed. The fruits are broadest in the middle, and the epidermis has a characteristic, undulating, longitudinal pattern which is built up from small spikes (Körber Grohne 1967). Eight fruits and some fruit wall fragments were identified as *Fallopia convolvolus* because they had this characteristic pattern on their surface, and because the fruits were triangular and broadest in the middle (Fig. 6b). The epidermis pattern was visible on all fruits and fruit wall fragments. Three carbonised seeds were identi-

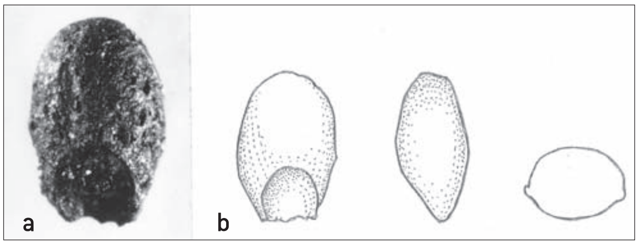

Fig. 5. a) Photograph of the millet grain. b) Drawings of the millet grain from the dorsal side, the lateral side and in cross section. Scale bar 1mm. Drawing/photo B. Lundeberg.

Table 2. Size measurements of cereal grains and seeds of cultivated plants.

Species	Number of grains/ seeds	Length			Breadth			Thickness		
		Max.	Av.	Min.	Max.	Av.	Min.	Max.	Av.	Min.
Hordeum vulgare	50	6.78	5.80	4.96	3.28	2.73	1.84	2.76	2.24	1.44
Avena sp.	16	6.96	5.49	4.16	2.48	1.92	1.68	1.92	1.63	1.44
Linum ussita-tissimum	4	3.84	3.66	3.34	1.70	1.60	1.54			
Panicum sp.	1	1,84			1,2			0,9		

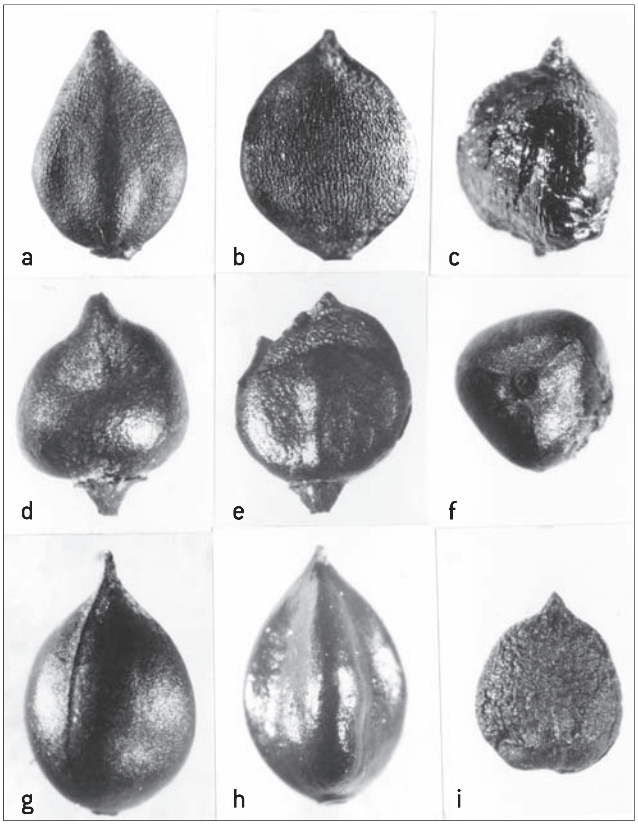

Fig . 6. Weeds and ruderal plants. Carbonised fruits (a-b and d-g) and seeds (c and i). a) Persicaria hydropiper, b) Fallopia convolvulus, c) Fallopia convolvulus, d-e) Persicaria lapathifolium, f) Persicaria maculosa, g) Persicaria minor, h) Persicaria minor, modern fruit, i) Persicaria lapathifolium. Scale bar 1mm. Photo: B.Lundeberg.

fied as *Fallopia convolvolus*. They had the same shape as modern seeds of this species, with a shiny surface and longitudinal stripes (Fig. 6c).

The surface of seeds of *Stellaria media* is covered with star-shaped bulges. On the broadside of the rounded seeds these bulges are arranged in concentric circles, on the edges these bulges form parallel lines. These distinctive marks could be recognized on 14 seeds and seed fragments. The pattern was almost worn off on some of the fragments. These seeds and seed fragments were identified as *Stellaria media* because they had the same shape, size and epidermis sculpture as this species (Fig. 7g–h).

Seen from the side, fruits of *Galium* have the shape of a kidney. The fruits have an oval depression on the side that curves inwards. Six carbonised plant remains had this characteristic shape (Fig. 8c). The identification to species level is difficult because the size of *Galium* fruits is variable. Charring experiments with modern fruits of *Galium aparine* and *Galium spurium* showed that carbonised fruits of these species had the same rough pattern on the surface. For these reasons it is difficult to distinguish between carbonised fruits of *Galium aparine* and *Galium spurium*. In prehistory, *Galium aparine* was a weed in cornfields. Carbonised remains of Galium aparine from the Iron Age are found in many countries in Europe, including Denmark, Sweden and England (Helbæk 1954:250–261, Hjelmquist 1955, Godwin 1956). Possibly this species was also a weed at Ullandhaug?

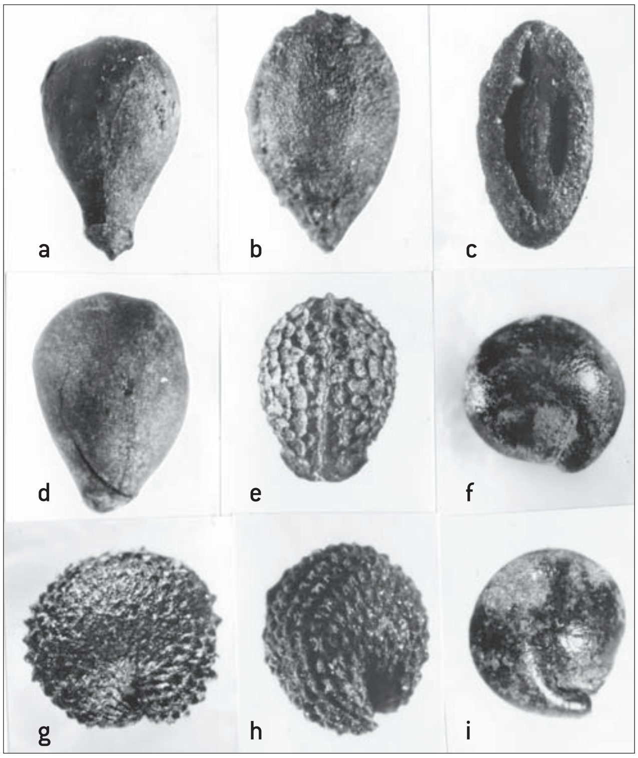

Fig. 7. Weeds and ruderal plants: a) Galeopsis lanadum, b) Urtica urens, c) Plantago lanceolata, d) Galeopsis tetrahit, e) Euphorbia helioskopia, f) Chenopodium album, g-h) Stellaria media, i) Chenopodium album. Scale bar 1mm. Photo: B. Lundeberg.

16 black, shiny seeds with an almost circular outline were identified as *Chenopodium album*. The seeds had a characteristic bulge and a small notch on their ventral side (Fig. 7f, i).

Three seeds were identified as *Spergula arvensis* because they had a shape like a discus, with small papilla on the surface and a narrow brim at the outer edge (Fig. 8b)

The basis for identification of fruits of *Ranunculus acris* and *Ranunculus repens* are their shape and their epidermis-pattern, which is formed as a reticulum (Helbæk 1958). *Ranunculus repens* has a pattern with bigger masks than *Ranunculus acris*. Four carbonised fruits had the characteristic shape for fruits of *Ranunculus*. Two of them were identified as *Ranunculus acris*, the other two as *Ranunculus repens* (Fig 8a).

Three carbonised fragments were identified as parts of the fruit wall of *Raphanus raphanistrum* (Fig. 8d). The fragments had wall bars in the longitudinal direction with hexagonal or pentagonal cells between them, just like the fruit wall of recent fruits of this species which were boiled in NaOH to dissolve and remove the outer part of the fruit wall. According to Helbæk (1964), the outer part of the fruit wall of *Raphanus raphanistrum* will usually be destroyed when carbonised. The inside of the charred fragments were smooth and shiny, with small stripes. Seeds of *Raphanus raphanistrum* contain oils that will boil when exposed to heat. Therefore, carbonised seeds of this species will easily be damaged and not recognizable (Helbæk 1964).

Seeds of *Euphorbia helioscopia* are egg-shaped and have a characteristic epidermis pattern, formed as a reticulum with a longitudinal wall bar on each side. Two carbonised seeds had these distinctive marks (Fig. 7e).

Nine pieces could be identified as fruits of *Galeopsis* because they were drop shaped with a circular mark on the pointed end. One side of the fruit wall had an edge or a line starting at the pointed end and running to the middle of the fruit. Five of these fruits were identified as *Galeopsis lanadum* because they were slender and a bit extended near the pointed end (Fig. 7a). The other four fruits were broader, and their outline was nearly egg shaped. The pointed end was relatively broad, which is typical for fruits of *Galeopsis tetrahit* (Fig. 7d)

Four carbonised fruits and one seed had a shape like the shape of fruits and seeds of *Urtica* (Fig. 7b). That means an egg-shaped outline with an acute end and convex lateral faces. The most important characteris-

tic which is used to distinguish between fruits of *Urtica urens* and *Urtica dioica* is the size. The fruits of *Urtica dioica* are much smaller than fruits of *Urtica urens*. The size of the carbonised fruits of *Urtica* found in the samples tells us that the species *Urtica urens* most likely grew at Ullandhaug.

Other wild species

Seeds of *Plantago lanceolata* have an oval outline, with a convex dorsal side and a concave ventral side. That means that they have the shape of a boat. In the middle of the ventral side is an oblong hilum (Helbaek 1954). One carbonised seed of *Plantago lanceolata* was found among the plant remains from Ullandhaug (Fig. 7c).

Four uncarbonised fruits, which were identified as *Carex pilulifera,* were found in the cultural layer on the floor of house 3. The identification was made on the basis of shape, size and epidermis structure. *Carex pilulifera* is a pioneer on burnt ground (Gimingham 1972). One carbonised fruit had a shape and size that corresponded with the shape of modern fruits of *Carex pallescens.* The fruit was long and slender, and broadest in the middle. The lumen of the epidermis cells had a characteristic, tiny bulge. Twelve other carbonised fruits had the characteristic triangular shape of *Carex.* The epidermis structure was not well preserved. However, two of these fruits had a shape like *Carex serotina* (Nilsson & Hjelmquist 1967).

One oblong, almost boat shaped fragment, with tiny longitudinal stripes, was identified as half of a fruit wall of *Cirsium vulgare.*

Three small and shiny seeds found in the cultural layer on the floor of house 3 were identified as *Montia Fontana,* based on their size, shape and a characteristic pattern of clearly limited epidermis cells.

Two carbonised seeds had an elliptical shape, one pointed end and small rounded cells on the surface, like seeds of *Polygala.* The size of the seeds pointed to *Polygala vulgaris.*

One uncarbonised, egg shaped seed fragment had the characteristic surface of seeds of *Viola*. The elaiosome was missing. The size of the seed corresponded to that of *Viola canina*.

Arctostaphylos uva-ursi has stone fruits, with several seed bearing kernels in the centre of the pulp. Each kernel has a shape like a section of an orange. Three carbonised plant remains from the Ullandhaug material

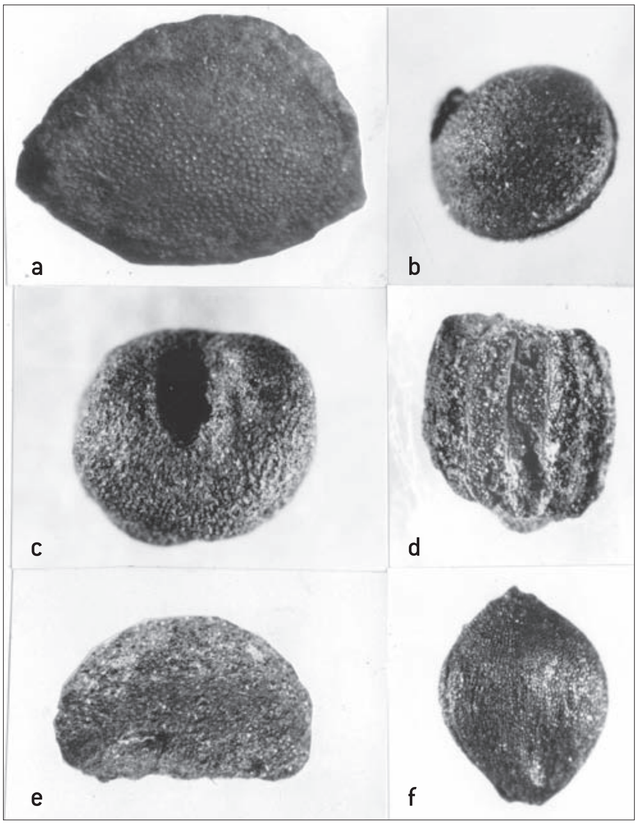

Fig. 8. Weeds and wild species: a) Ranunculus repens with characteristic reticulum on the fruit wall, b) Spergula arvensis, c) Galium aparine, d) Raphanus raphanistrum, fragment of the fruit wall, e) Arcostaphylos uva-ursi, f) Scirpus lacustris Scale bar 1mm. Photo: B. Lundeberg.

Table 3. Measurements of seeds and fruits of weeds and wild plants.

Weeds	Number of seeds/ fruits	Length or Diameter	Wild plants	Number of seeds/ fruits	Length or Diameter
Chenopodium album	16	1.2 – 1.6	Arcto-staphylos uva-ursi	3	2.7 – 2.9
Euphorbia helioscopia	2	2	Carex pallescens	1	2
Fallopia convolvulus	8	2.5 – 3.1	Carex pilulifera	4	1.5 – 1.7
Galeopsis lanadum	5	2.3 – 2.6	Carex serotina-type	2	1.1 – 1.4
Galeopsis tetrahit	4	2.4 – 2.9	Cirsium vulgare	1	3,2
Galium aparine	6	1.8 – 2.0	Montia Fontana	3	1.0 – 1.1
Persicaria lapathifolium	56	1.8 – 2.4	Plantago lanceolata	1	2,3
Persicaria maculosa	3	1.9 – 2.4	Polygala vulgaris	2	2.1 – 1.9
Persicaria minor	4	2.0 – 2.4	Ranuncu-lus acris	2	2.5 – 2.7
Persicaria hydropiper	5	2.4 – 2.7	Scirpus lacustris	1	1,8
Raphanus raphanistrum	1	3,1	Viola canina	1	1,6
Ranunculus repens	2	2.5 – 2.6			
Spergula arvensis	3	0.9 – 1.2			
Stellaria media	10	1.1 – 1.5			
Urtica urens	4	2.0 – 2.2			

Table 4. Plant remains found in fireplaces F and cultural layers CL on the floor of the house ruins.

	House1	House 2		House 3					
Cultivated plants	F 5 – 6	F	F	F 1	F 2	F 5	F 7	C L	Total
		Top	Base						
Hordeum vulgare	70	217	134	62	109	91	38	32	753
Avena sp.	1	4	4	1	3	2	1	3	19
Linum ussitatissimum		1	1					2	4
Panicum sp.					1				1
Weeds, ruderal plants									
Chenopodium album	1	1	3		5	1	3	2	16
Euphorbia helioscopia	1		1						2
Fallopia convolvolus	2	4	1		1	2		1	11
Galeopsis lanadum		2	2			1			5
Galeopsis tetrahit		2		1	1				4
Galium aparine	1	2				2		1	6
Persicaria lapathifolium	5	14	10	3	12	9		3	56
Persicaria maculosa		2	1						3
Persicaria minor		1				1		2	4
Persicaria hydropiper		2	1					2	5
Raphanus raphanistrum				1	1			1	3
Ranunculus repens						1		1	2
Spergula arvensis		1			2				3
Stellaria media	2	2	2	1	4	2		1	14
Urtica urens		1			1			2	4
Wild species									
Arctostaphylos uva-ursi		1	1					1	3
Carex pallescens								1	1
Carex pilulifera								4	4
Carex serotina-type								2	2
Carex sp.	1			1		1		7	10
Cirsium vulgare								1	1
Montia fontana	1							2	3
Plantago lanceolata								1	1
Polyala vulgaris		2							2
Ranunculus acris			1					1	2
Scirpus lacustris								1	1
Viola canina								1	1

were identified as kernels of *Arctostaphylos uva-ursi* because they had this characteristic shape and a rough surface, like the kernels of this species (Fig. 8e).

One carbonized fruit was identified as *Scirpus lacustris* (Fig. 8f). The fruit was built up from three carpels and measured 1.75 mm. The surface was shiny, with a characteristic pattern of well defined cells like recent fruits of this species. Fruits of *Blysmus, Eleocharis* and *Trichophorum* were also considered when working with the identification of this fruit.

Many of the charred plant remains were too poorly preserved to be identified. Many of the small objects that could not be identified were possibly seeds and fruits of weeds and wild plants. About forty heavily corroded plant remains were ball-shaped, with no epidermis fragments left on the surface. These objects could be seed remains of species from *Brassicaceae* or *Fabaceae.*

Discussion

Cultivated plants

Barley and oats: The analysis shows that lax-eared four-rowed barley was the main crop at Ullandhaug in the Migration Period. However, the presence of six rowed barley in the fields cannot be ruled out. In the samples analysed, only hulled barley was found. It can be assumed that *Avena* was another important crop. However, the lack of botanical evidence, like preserved glumes or floret bases, does not allow identification to the level of species. Since the number of oat grains is small in relation to the number of barley grains, it is likely that oats were not cultivated in separate oat fields, but grew scattered in the barley fields as apparently was the case elsewhere in Europe in this period (Helbæk 1944).

The main line in the development of barley cultivation in northwest Europe was known in the 1960s, when the excavation of the site Ullandhaug was carried out. In the first part of the history of agriculture, naked barley *(Hordeum vulgare* var. *nudum*) was an important crop. During the last part of the Bronze Age and the first part of the Iron Age naked barley almost disappeared and the importance of hulled barley increased (Hjelmquist 1955, Helbæk , 1957, 1958 , van Zeist 1968).

Since 1972, our knowledge of prehistoric agriculture has greatly increased. Cereal cul-

tivation in southwest Norway is documented by pollen analysis as early as 2200 BC (Prøsch-Danielsen & Simonsen 2000). During the last decades, many archaeological excavations, accompanied by archaeobotanical investigations, have been carried out in Norway, many of them in the county of Rogaland. Archaeological excavations of several sites on the island Hundvåg uncovered rich finds of macrofossil plant remains, among them cereal grains dated to the Late Bronze Age (Juhl 2001). At Gausel, Stavanger, 15 prehistoric houses were excavated. Here the oldest carbonised remains of cereals were found in Pre-Roman Iron Age deposits (Børsheim & Soltvedt 2002). At Forsandmoen, soil samples from 100 prehistoric houses were analysed. Plant macrofossils from these soil samples have provided evidence of the cultivation of cereals in Rogaland through a continuous period of about 2000 years, ending about 600 AD (Bakkevig 1991).

The results of the archaeobotanical investigations from these sites point out emmer (*Triticum dicoccum*) and naked barley (*Hordeum vulgare* var.*nudum*) as the most common cereals in the Late Neolithic and Bronze Age. As time passed by, the importance of these cereals decreased, and hulled barley (*Hordeum vulgare* var. *vulgare*) became the most important cereal, but also oats (*Avena* sp.) became common during the Iron Age. In the Migration Period, hulled barley was the predominant cereal. Analysis of the carbonised remains of cereals from several sites, also in eastern parts of Norway and in Sweden, suggest that hulled barley was the predominant cereal also in these areas in the Migration Period (Viklund 1998, Bakkevig 2002).

To sum up, the archaeobotanical investigations done in the last decades, as well as evidence from older investigations, point to hulled barley as the most common cereal in northwest European countries in the Migration Period. Oats were also cultivated. Thus the finds of hulled barley and oats at Ullandhaug correspond with results from Norway and from the other countries in northwest Europe.

Millet: On the basis of only one corroded grain of millet (*Panicum* sp.), it cannot be confirmed whether this cereal might have been cultivated at Ullandhaug. Perhaps millet was present only as a weed in the fields? Other archaeobotanical evidence of millet is not reported from this part of Norway.

Flax: It can be assumed that seeds of flax (*Linum ussitatissimum*) are underrepresented in the samples because these seeds are given low preservation chances when heated, due to their oil content. Carbonised seeds of this species often are corroded to a level which makes identification difficult (Helbæk 1959). Two of the flax seeds were found in one of the fireplaces. These seeds most probably were lost during food preparation, which indicates that flax seeds possibly were a part of the diet. We do not know whether the flax plant was used as a source of fibres by the inhabitants of Ullandhaug. Flax also has been reported from other sites in this area. Some carbonised seeds were found in two houses dated to the Pre-Roman Iron Age and the Migration Period at Gausel, which is situated near Ullandhaug (Børsheim & Soltvedt 2002). It therefore can be assumed that flax probably was cultivated in southwest Norway at that time, possibly also at Ullandhaug.

The fireplaces were the centres for food processing and cooking activities. At Ullandhaug cereal grains were ground in mills located near the fireplaces (Myhre 1969). Most of the carbonised cereal grains and seeds of weeds were found in soil samples collected in the fireplaces. These grains and seeds probably have been lost by accident during food preparation. This indicates that not only cereals, but also seeds of weeds might have been a part of the diet. Seeds from weeds growing in the fields could easily be mixed with the crop when harvesting. Tall growing species or climbing ones such as *Fallopia convolvolus* could have become a constituent of the harvested crop. We have no evidence that seeds of weeds were collected intentionally in order to supplement the diet.

No storage deposit containing harvested, but unprocessed crops was found. The archaeobotanical finds at Ullandhaug therefore are not a good source of information about harvesting techniques. However, the plant remains hidden in the soil provided an important contribution to the knowledge of the diet and daily life on the farming settlement.

Weeds and ruderal plants

Because the excavators of the site Ullandhaug were inexperienced, and because they primarily searched for cereals, a great part of the smaller plant remains like small seeds and spikelet fragments were not taken care of. After all, several small seeds were collected, indicating that greater quantities of these plant remains were originally present in the cultural soil.

The species *Persicaria lapathifolium*, *Persicaria maculosa*, *Fallopia convolvolus*, *Chenopodium album*, *Stellaria media*, *Spergula arvensis* and *Galeopsis tetrahit* are common weeds among prehistoric cereals in northwest Europe (Helbæk 1954). Species that occur less frequently in prehistoric plant material were also found among the plant remains from Ullandhaug. Some of these are weeds from the fields (*Raphanus raphanistrum, Euphorbia helioscopia*, *Galeopsis lanadum*), others are species growing in ruderal land

or in other plant communities influenced by human activities (*Galium aparine, Plantago lanceolata, Urtica urens, Persicaria hydropiper, Pesicaria minor, Ranunculus repens*). The weed flora indicates that conditions like soil type, moisture content, pH and nutrient content in the fields varied considerably. The presence of species like *Raphanus raphanistrum* and *Spergula arvensis* indicate that a part of the cultivated land was poor in nutrients and had low pH. *Stellaria media*, *Persicaria minor* and species of *Galeopsis* suggest that some of the soil at the farm site was damp and humus-rich. Chemical analyses of the soil near the south western entrance of house 3 showed that the soil in this area had a high content of phosphate. Pottery fragments indicate that rubbish was thrown out from this entrance (Provan 1971). Plants like *Urtica urens*, *Galium aparine*, *Ranunculus repens, Chenopodium album* and *Galeopsis tetrahit* which prefer soil rich in nutrients may have grown here. On rainy days water rich in nutrients has seeped down from the place where rubbish was deposited to the area near the well. In this wet area *Persicaria hydropiper* and *Montia fontana* may have grown.

Other wild species

The species *Carex pallescens*, *Carex pilulifera, Viola canina, Arctostaphylos uva-ursi* and *Polygala vulgaris* are not weeds or ruderal plants, but may have grown in the natural vegetation near the farm site. Pollen analytical investigations show that the vegetation in the neighbouring areas was heathland (Simonsen1968), which is a habitat for these species. *Carex pilulifera* is also a pioneer on burnt ground. This species probably settled in the burnt out ruins soon after the fire had destroyed the farm.

Probably, there were pastures near the farm site. The species *Cirsium vulgare* and *Ranunculus acris* possibly grew in areas with grazing land. *Plantago lanceolata* has been considered to be the most reliable indicator plant of farming practice including cultivation of arable land and grazing land (Fægri 1970). This species may have grown on areas near the fields, on a roadside, on a hill or in a pasture or meadow.

One part of house 3 was used as a cowshed. It can be supposed that hay was carried into the house to feed the cattle. The people at the farm most likely used many different ecosystems as hayfields (Myhre 1969). It is possible that some of the seeds found in the cultural layers from the floor in house 3 may originate from plant material brought into the house as part of the hay. The fruits of *Carex* were most likely brought into the house in this way. It is also possible that seeds might have been brought in by the livestock or originated from faeces of the cattle on the floor. The species *Scirpus lacustris,* which grows in ponds and lakes, have long and strong stems. In Germany, this species has been used for roofing (Frahm 1972). Maybe it was used for this purpose at Ullandhaug?

Fig. 9. The reconstructed iron age farm site at Ullandhaug as it looks today. Photo: Terje Tveit AM.

Conclusion

Ullandhaug was the first prehistoric site in Norway where macrofossil plant remains were collected systematically from cultural layers to be analysed and identified. This article has focused on the plant remains from Ullandhaug as a part of the picture of the history of plant cultivation in Norway. Cereal grains and remains of weeds represent a proof of agricultural activity at the settlement. The identified plant species include those cultivated plants and weeds that are most common in other northwest European countries during the Migration Period. Weeds and ruderal plants that occur less frequently among prehistoric plant remains were also found at Ullandhaug. In addition, remains of several wild species, that were part of the natural vegetation mosaic around the site, were hidden in the cultural layers. These species were probably gathered by the farmers for various purposes.

The Iron Age farm at Ullandhaug is reconstructed and rebuilt. It is open to the public and the information gained from the archaeobotanical study is incorporated in the presentation.

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